GEOLOGY

Physiographic Region

Most of the basin lies entirely within the dissected Salem Plateau Subdivision of the Ozark Plateau (Figure nd). The basin, however, has some distinct topographic features associated with the rapidly descending Ozark Escarpment that forms the prominent boundary between the high relief Ozark Plateau and the low relief Mississippi Alluvial Plain Divisions (Missouri Department of Natural Resources 1986). Land elevations range from 1,230 ft NGVD (National Geodetic Vertical Datum of 1929) in the Castor River headwaters to 314 ft NGVD at the Headwater Diversion Channel confluence with the Mississippi River.

Geology

The geology of the basin is greatly influenced by the nearby St. Francois Mountains uplift (Ozark Dome) which has exposed outcrops of irregularly distributed Precambrian igneous rock and elevated the upper watersheds (MDNR 1986, Figure ge). The tilt of the uplifted strata exposes progressively younger and less resistant limestone and dolomite bedrock in all downstream easterly and southeasterly directions (MDNR 1984). The fractured limestone and dolomite bedrock on all slopes is overlaid by a thick (200 ft at some sites) weathered layer of cherty residuum (Soil Conservation Service 1981).

The ancient uplift has had the time and energy to carve moderately wide floodplain valleys which are overlaid with a deep gravel alluvium that is occasionally interrupted by igneous outcrops (pink granite shut-ins) and remnant limestone bluffs. The soluble cherty residuum, fractured bedrock and unconsolidated alluvium allow rapid groundwater movement that sustains most base flows during dry periods and yields clear water. Springs, however, are not common in the basin. Occasional karst features are restricted to the northeast edge of the basin near the city of Jackson in the upper Byrd Creek and Hubble Creek watersheds.

Soil Types

Soils in the basin are transitional from the dominant Ozark Border region on the west side to the secondary Central Mississippi Valley Wooded Slopes region on the east side (MDNR 1986). Soils formed in the upland loess and cherty limestone residuum are typically infertile, droughty, slightly acidic, extremely gravelly (65% chert by volume) and generally suitable for only woodland and grass production (SCS 1992 and 1986). The more fertile soils formed in the lowland alluvium contain sand, silt, loam and clay components that are marginally to highly suitable for improved pasture and row crop production (SCS 1981).

The primary soil series associated with the basin are: (moving upstream in the basin) Sharkey, Falaya, Wakeland, Wideman and Elk in the bottoms; Holstein, Peridge, Poynor, Goss and Clarksville on the

slopes; and Menfro, Goss and Hilderbracht on the ridgetops. Unfortunately, all of these soil classifications share two distinct characteristics -- a large volume of chert which is responsible for excessive gravel bedloads, and severe to hazardous erosion potential when disturbed.

The basin has some of the highest erosion potential in the state. Annual sheet and rill erosion on tilled land (24-30 tons/acre) and undisturbed forest land (0.25-0.50 tons/acre) exceeds most of the other basins in the state (Anderson 1980). Sheet and rill erosion on permanent pasture, however, are considered acceptable with a rate of 2-5 tons/acre. Gully erosion (0.3-0.8 tons/acre) often exceeds the severe rates in north Missouri and is uncharacteristic of the remainder of the Salem Plateau.

Despite the high potential for serious erosion on disturbed soils, relatively little sediment (1.8 tons/acre/year) actually enters basin streams. Active soil conservation programs, good local land management practices, low topographic relief and relatively few acres in row crop production all contribute to the currently low fine-sediment loads in the lower watersheds. Historically, poor timber management practices and conversion of woodland to pasture have contributed to the more serious problem of shifting gravel deposits in the stream channels of the upper watersheds.

Watershed Area

The drainage area of the basin is 1,207 square miles. Three primary watersheds, Castor River, Whitewater River and Crooked Creek drain 81 percent of the basin (Table 1). The Cape La Croix Creek watershed (50.6 square miles), which is sometimes included as part of the basin in SCS and U.S. Department of Agriculture (USDA) publications, is diverted directly into the Mississippi River. Therefore, the city and suburbs of Cape Girardeau are not part of the Headwater Diversion Basin. Also, Dark Cypress Swamp (Hawker, Cane, Dry, Malone and Gizzard Creeks) drains directly into the Diversion Channel below the Greenbrier Bridge and is included in the Diversion Channel subbasin, not the Castor River watershed.

Stream Mileage, Order and Permanency

A total of 2,366 streams occupying 2,984 miles of channel were identified, ordered, measured (by hand dividers) and classified as either intermittent or permanent as indicated on U.S. Geological Survey (USGS) 7.5 minute topographic maps (Table 2). All 104 third order and larger streams were tabulated by name, length, order and basin position (Table 1-A). The apparently liberal designation of 715 miles of permanent streams on USGS topographic maps does not agree with the designated 439 miles of permanent streams classified under Missouri Water Quality Standards (CSR 1981). The Missouri Water Quality Standards figure is probably the more accurate estimate. The percentages of second and third order permanent stream mileage measured from USGS topographic maps appear to be much too high, based on field observations by Fisheries District staff.

In this part of Missouri, only 2.7 square miles of watershed are needed to maintain each mile of permanent stream (MDNR 1984). The ratio of watershed area to length of permanent stream is probably the lowest of all Missouri river basins. The high incidence of stream permanency is the result

of basin geology and the abundant water supply provided by favorable precipitation, runoff and evaporation patterns in the southeast portion of the state. The influence of geology and weather patterns can even affect stream permanency within the basin. Streams in the southeast portion of the basin tend to have more permanent water and lower watershed to stream length ratios.

Channel Gradient

Gradient information for 80 third order stream channels has been tabulated (Table 2-A) and is on file at Fisheries District headquarters for convenient reference and conversion to graphical gradient plots. Diverse channel gradients throughout the basin reflect the complicated influences of variables associated with transcending geological formations, bedrock composition, channel age and watershed size.

Steeper gradients on the west side of the basin (Castor River) are generally a result of the Ozark Escarpment transition from the Salem Plateau to the Mississippi Alluvial Plains. However, steeper gradients also tend to occur in some east sloping drainages (Bear Creek and Little Whitewater Creek) because of the tilt provided by the St. Francois Mountains uplift. The uplift has also exposed scattered outcrops of erosion resistant granites that provide hardpoints, vertical control and rigid channel boundaries which produce some undulating channel profiles in the higher elevations in the northwest part of the basin.

Table 1. Drainage area of major watersheds, Headwater Diversion Basin, Missouri. (Modified from: USDA. 1981. Watersheds in Missouri) The Hydrologic Unit Code 07140107- is the prefer to the USDA code.

USDA Code	Watershed	Max Ord	Area (acres)		Area (Sq. Mi)	% of Basin
	Total Castor River Subbasin	6°	286,274	***	447.3	37.4
020	Bear Creek	5°	(56,973)		(89.0)	(7.4)
010	Upper Castor River	5°	(135,266)		(211.4)	(17.6)
030	Lower Castor River	6°	(94,035)		(14.9)	(12.3)
	Castor R. above Zalma gage	6°	(270,270)	**	(423.0)	(35.3)
050	Total Whitewater River Subbasin	6°	217,987		340.6	28.4
	Little Whitewater Creek	5°	(59,981)		(93.7)	(7.8)
	Byrd Creek	5°	(43,218)		(67.5)	(5.6)
040	Total Crooked Creek Subbasin	5°	118,976		185.9	15.5
060	Total Hubble Creek	5°	59,027		92.2	7.7
	Total Dark Cypress Swamp	4°	52,736		82.4	6.9
080	Total Ramsey Creek	4°	31,360		49.0	4.1
TO	TAL HEADWATER DIVERSION BASIN		766,360	*	1,197.4	100.0

^{() =} Watershed subtotal within a subbasin

^{*** =} Does not include Dark Cypress Swamp

^{** =} Does not include Dark Cypress Swamp or Bear Creek

^{* =} Does not include Cape La Croix Creek

Table 2. Stream mileage summary, by order, subbasin and permanency, Headwater Diversion Basin, Missouri. (Measured directly from USGS 7.5 minute topographic maps).

		(inc			EAM MI eaches of 1							
D	DIVERSION CHANNEL* CASTOR RIVER WHITEWATER RIVER											
0.1	# of	Total	%	# of	Total	%	# of	Total	%			
Order	Reach.	Mi.	Perm.	Reach.	Mi.	Perm.	Reach.	Mi.	Perm.			
7°	1	17.65	100.0	-	-	-	-	-	-			
6°	1	16.80	100.0	1	18.75	100.0	1	20.10	100.0			
5°	-	-	-	2	43.60	100.0	3	24.55	100.0			
4°	3	10.35	72.0	9	44.30	100.0	6	57.35	100.0			
3°	15	55.20	65.4	40	70.90	81.7	29	68.55	87.7			
2°	68	69.30	26.0	195	198.40	29.6	151	141.20	49.0			
1°	288	228.10	0.4	867	701.55	0.5	667	536.80	0.5			
TOTAL	376	397.40	24.3	1114	1077.50	21.1	857	848.55	27.6			

	(incl		STREAM M filed reaches of	IILEAGES 1° and 2° mile	eage)							
	CROOKED CREEK HUBBLE CREEK											
Onder	# of	Total	%	# of	Total	%						
Order	Reach.	Mi.	Perm.	Reach.	Mi.	Perm.						
7°	-	-	-	-	-	-						
6°	-	-	-	-	-	-						
5°	1	24.80	100.0	1	4.65	100.0						
4°	4	29.05	100.0	2	10.45	100.0						
3°	14	33.50	86.7	6	18.30	97.3						
2°	78	78.00	32.8	35	36.35	34.7						
1°	<u>365</u>	<u>296.85</u>	<u>1.0</u>	<u>179</u>	128.45	0.5						
TOTAL	462	462.20	24.1	223	198.20	23.3						

^{* =} Includes Dark Cypress Swamp and Ramsey/Marquette subbasins.

Table 2 continued

	_	FAL BASIN		MILEAGE ° and 2° milea	ge)							
	# of # of Total Miles % Permanent											
Order	Streams	Reaches	Miles	Permanent								
7°	1	1	17.65	17.65	100.0							
6°	2	3	55.65	55.65	100.0							
5°	5	7	97.60	97.60	100.0							
4°	17	24	151.50	148.60	98.1							
3°	80	104	246.45	201.05	81.6							
2°	423	527	523.25	184.15	35.2							
1°	1,839	2,366	1,891.75	10.50	0.6							
TOTAL	2,366	3,032	2,983.85	715.20	24.0							

Table 1-A. Stream mileage summary, Headwater Diversion Basin, Missouri. (All profiled 3° and larger tributaries, tabulated by order, subbasin and hierarchal mile position from the headwaters of Castor River to the confluence with the Mississippi River)

MILE			7°	6°	5°	4°	3°	2°	1°	TOTA
MARK	TR	BUTARY NAME	MILE	MILES	MILE	MILE	MILES	MILES	MILES	L
			S		S	S				MILES
68.70	Mainstem of the C	astor River		18.75	30.50	12.25	3.60	3.30	0.30*	68.70
61.45	ID# 340830A**						1.05	0.85	1.55*	3.45
61.30	ID# 340830B						0.50*	0.30*	1.20*	2.00
57.35	Dry Branch						2.65	1.35*	0.60*	4.60
49.25	Henderson Creek					0.40	2.75	0.95	1.10*	5.20
	0.40	Indian Creek					1.30	1.70	0.50*	3.50
47.70	Grounds Creek					3.30	0.70	1.20*	0.50*	5.70
	3.25	ID# 320802					0.60	0.55	0.60*	1.75
44.45	Greasy Creek						4.05	1.85*	0.80*	6.70
43.60	Whitener Creek						0.60	2.10	0.85*	3.55
33.90	Shetley Creek					3.65	4.55	0.50*	0.70*	9.40
	3.65	East Prong					2.40	1.15*	0.25*	3.80
	3.90	ID# 310712					0.70*	0.15*	0.50*	1.35
33.05	Gimlet Creek						1.40	1.15	0.60*	3.15
30.60	Big Creek					6.05	2.85	0.95*	0.55*	10.40
	2.70	Little Creek					2.20	0.40	1.35*	3.95
	3.05	Johnson Hollow					0.55*	0.45*	0.65*	1.65
	5.75	East Fork					4.40	1.00*	1.05*	6.45
	6.05	West Fork					2.45	0.90*	0.50*	3.85
29.65	Trace Creek						5.80	2.95*	0.20*	8.95
27.00	Grassy Creek						2.15	5.00	0.55*	7.70
26.45	Campground Hollo)W					1.25	1.45*	0.90*	3.60
22.30	Turkey Creek					4.20	0.95	1.75*	0.60*	7.50
	4.40	Gizzard Creek					0.85	1.35*	0.55*	2.75
18.80	Bear Creek				13.10	3.80	1.50	0.50*	1.40*	20.30
	2.75	Andys Creek					1.50	0.35*	0.50*	2.35
	4.70	Barnes Creek					2.10	0.85*	1.50*	4.45
	8.35	Goose Creek					1.55*	2.25*	1.15*	4.95

Table 1-A continued

MILE					7°	6°	5°	4°	3°	2°	1°	TOTA
MARK		TRI	BUTARY NAI	ME	MILE	MILES	MILE	MILE	MILES	MILES	MILES	L
					S		S	S				MILES
		9.40	McCabe Cree	k					1.50*	1.65*	1.40*	4.5
		11.85	ID# 290613						0.40*	1.10*	0.85*	2.3
		13.15	West Fork					2.65	0.95*	0.20*	0.85*	4.6
			0.65	ID# 290602					2.35	0.65*	0.55	3.5
			2.65	White					0.65*	1.00*	1.20*	2.83
				Hollow								
		16.90	Graham Hollo				12.10		0.75	0.85*	0.80*	2.40
	ŀ	BEAR CE	REEK SUBBA	SIN TOTALS			13.10	6.45	13.25	9.40	10.20	52.4
		a .							0.00	2.20.4	1.004	4.0
17.15	Lick Log (0.80	2.20*	1.00*	4.0
16.30	Jesse Cree				1				0.55* 3.20*	1.35*	1.30*	3.2
12.70 8.45	Pond Cree				1			8.00		2.60*	0.80*	6.6 13.6
8.43	Perkins Cr	5.75	ID#290907					8.00	1.60 0.70*	3.15 1.60*	0.85* 0.70*	3.0
		8.00	ID#290907 ID#300836						0.70*	0.95*	0.70*	2.1
0.00	CASTOR		SUB-TOTALS			18.75	43.60	44.30	70.90	54.55	32.50	254.6
0.00	CASTOR	KIVEK	SUB-TUTALS			16.73	43.00	44.30	70.90	34.33	32.30	234.0
29.90	Hawker Cı	rek						4.75	0.75	3.00	2.05*	10.5
27.70	THEWKEI CI	4.75	Clubb Creek		† 			7.13	4.80	0.85*	1.05*	6.7
		5.45	Virgin Creek		†				0.60	1.75*	0.90*	3.2
28.45	Cane Cree		virgin creek						13.70	0.55	0.80*	15.0
28.30	Dry Creek								9.95	3.25*	1.10*	14.3
25.45	Malone Cr								3.90	4.90	0.95*	9.7
22.70	Gizzard Cı								1.50	2.55*	0.65*	4.7
20.30	Crooked C						24.80	17.80	1.25	2.75	1.90*	48.5
20.30	CIOOKCU C	42.6	Summers Cre	ek			24.00	17.00	1.70	1.90	0.80*	4.4
		41.3	Huffman's Cr						0.95	1.30	1.25*	3.5
		31.8	Indian Creek	CCR					2.20	0.60*	0.70*	3.5
		24.8	Little Crooke	d Creek				5.65	0.75	1.70	1.00*	9.1
		24.0	5.7	ID# 310932				3.03	0.80*	0.90*	0.55*	2.2
			4.6	Limbaugh Branc	h				1.85*	0.35*	1.35*	3.5
		20.8	Hurrican Cree		11			4.40	9.20	0.25*	1.15*	15.0
		20.0	4.4	Cedar Branch				0	0.55	4.10	1.40*	6.0
		20.65	Opossum Cre						2.25	1.10	2.15*	5.5
		14.7	ID# 300913						0.90*	1.20*	1.80*	3.9
		10.3	Hog Creek					1.20	8.90	1.10	1.45*	12.6
			1.25	Granny Creek					1.30	1.75*	1.00*	4.0
		3.9	ID# 301128						0.90*	1.30*	0.45*	2.6
	CROOKE		K SUBBASIN	TOTALS			24.80	29.05	33.50	20.30	16.95	124.6
18.55	No-Name								1.90*	0.80*	0.65*	3.3
17.65	Whitewate					20.1	4.5	25.30	4.90	0.40*	0.60*	55.8
		49.9	No-Name ID#	# 340 <u>93</u> 0					0.50	1.20	0.70*	2.4
		47.95	Martin Hollo	w Ck.					0.70	0.45	1.10*	2.2
		46.0	Blue Creek						4.10	0.70	0.50*	5.3
		41.8	Shrum Creek						2.95*	0.85*	0.60*	4.4
		38.8	Jack Creek						2.70	0.30	0.70*	3.7
		36.3	Lix Hollow C	Creek					0.75*	0.65*	0.80*	2.2
		29.35	Wolf Creek						3.60	1.10	1.80*	6.5
		24.6	Caney Fork					12.20	2.80	1.40	0.60*	17.0
			1.85	Sandy Branch					2.20	0.85*	0.70*	3.
			6.2	ID# 331134					0.90	0.50*	1.15*	2.:
			12.2	ID# 331117					0.40*	0.85*	0.55*	1.
		20.8	No-Name ID	# 321135					0.05*	0.55*	1.05*	1.
		20.1	Little Whitew	vater R.			17.7	2.00	2.70	1.35	0.55*	24.
			2.0	Panther Ck.					2.85	1.35	0.90*	5.
			6.7	Little Mjuddy C	k.				7.80	1.65*	0.75*	10.2
			11.2	Mayfield Ck.					4.60	1.15	0.55*	6.3
		ĺ	17.7	Stones Branch				1.70	1.50	0.30*	0.80*	4.3

Table 1-A continued

MILE						7°	6°	5°	4°	3°	2°	1°	TOTA
MARK		TRI	BUT	ARY NA	ME	MILE	MILES	MILE	MILE	MILES	MILES	MILES	L
						S		S	S				MILES
				1.7	ID# 320911					0.65*	0.85*	0.95*	2.45
				19.7	Baltimore Ck.					3.30	0.30*	0.90*	4.50
		16.85	Sch	nroder Brai	nch					1.10*	1.10*	0.40*	2.60
		14.0	Dil	lard Creek						4.10	0.60*	0.85*	5.55
		12.05	By	rd Creek				2.35	10.45	1.50	0.50	1.00*	15.80
				2.35	Cane Creek				5.70	2.50	2.55	1.60*	12.35
				0.1	Helderman Ck.					1.10*	0.50*	1.00*	2.60
				5.7	ID# 311204					2.10	1.75	1.70*	5.55
				10.9	Horrell Ck.					4.10	2.80*	0.75*	7.65
				12.8	ID# 321209					1.60	0.70*	0.50*	2.80
		10.25	No	-Name ID	#311236					0.50*	0.90*	0.50*	1.90
	WHITE	WATER F	R. SU	BBASIN	TOTALS		20.1	24.55	57.35	68.55	28.15	24.55	223.25
14.8	Bean Bra	anch							2.90*	1.00*	1.70*	1.15*	6.75
		2.9	No	-Name ID	# 301230					2.90*	0.10*	0.80*	3.80
12.0	No-Name	e ID#3012	28							1.00*	1.90*	0.55*	3.45
10.95	No-Name	e ID#3012	27							0.90*	0.80*	1.80*	3.50
9.45	Hubble (Creek						4.65	7.15	4.50	1.75*	1.15*	19.20
	4.65	Williams	Cree	k					3.30	7.90	0.80*	0.95*	12.95
		3.3	Rai	ndol Ck.						0.10	4.00	0.80*	4.90
	6.05	Foster Cr	eek							1.70	2.85*	0.45*	5.00
	11.0	No-Name	ID#3	311223						0.50*	0.65*	0.70*	1.85
	11.8	Goose Cr	eek							3.60	1.50	1.35*	6.45
	HUBBL	E CREEK	SUB	BASIN T	OTALS			4.65	10.45	18.30	11.55	5.40	50.35
2.25	Ramsey	Creek							2.70	7.20*	0.70*	1.10*	11.70
	2.7	Sals Cree	k							4.20*	1.60*	0.70*	6.50
0.9	Marquett	e Lake Cre	eek							0.90	0.05*	0.55*	1.50
0.0	Headwat	ers Diversi	on C	hannel		17.65	16.80		See C	astor River N	Iainstem		34.45
HEADWA	TERS DIV	VERSION	BAS	IN TOTA	LS	17.65	55.65	97.60	151.5	246.45	139.05	94.20	802.10
									0				

^{*=}intermittent to the nearest order on USGS topographic maps.

Table 2-A. Channel gradient summary, Headwater Diversion Basin, Missouri. (All profiled 3° and larger tributaries, tabulated by order, subbasin and hierarchal mile position from the headwaters of the Castor River to the confluence with the Mississippi River).

MILE		7°	6°	5°	4°	3°	2°	1°
MAR	TRIBUTARY NAME	GRAD	GRAD.	GRAD.	GRAD.	GRAD.	GRAD.	GRAD.
K								
68.70	Mainstem of the Castor River		1.65	7.33	17.31	36.81	43.64	123.33
61.45	ID# 340830A					52.29	68.94	83.87
61.30	ID# 340830B					76.20	37.67	100.00
57.35	Dry Branch					37.85	60.67	111.17
49.25	Henderson Creek				39.00	43.64	42.11	90.91
	0.40 Indican Creek					44.46	89.65	226.60
47.70	Grounds Creek				33.64	48.57	77.25	146.60

^{**=}un-named, mouth, Township, Range and Section.

Table 2-A continued

MILE			7°	6°	5°	4°	3°	2°	1°
MAR		TRIBUTARY NAME	GRAD	GRAD.	GRAD.	GRAD.	GRAD.	GRAD.	GRAD.
K		111201111111111111111111111111111111111		ora ib.	Old ID.	Ora ID.	Old ID.	ora ib.	ora ib.
	3.25	ID# 320802					51.83	76.73	117.17
44.45	Greasy Creek						43.90	76.00	110.00
43.60	Whitener Cre	eek					57.50	61.24	107.53
33.90	Shetley Cree					21.29	38.75	93.40	104.71
	3.65	ŭ					38.79	71.48	80.00
	3.90						76.86	100.00	80.00
33.05	Gimlet Creel						38.07	49.30	83.33
30.60	Big Creek	Trial C 1				18.02	41.05	76.84	109.10
	2.70						45.14	74.25	84.67
	3.05						63.82	95.33	123.08
	5.75 6.05						32.36	62.90	87.05
29.65	Trace Creek	West Fork					36.73 30.88	75.56 45.93	104.00 50.00
27.00	Grassy Creek						26.23	43.93	68.18
26.45	Campground						12.80	37.86	146.67
22.30	Turkey Creel					20.38	36.21	62.06	122.38
	4.40						46.35	50.81	145.45
18.80	Bear Creek				10.61	19.73	33.53	43.40	76.64
	2.75	Andys Creek					38.87	80.00	104.00
	4.70	Barnes Creek					29.10	40.00	72.60
	8.35	Goose Creek					27.55	53.33	69.57
	9.40	McCabe Creek					30.33	46.30	63.29
	11.8						34.00	59.10	90.24
	13.1					25.32	40.63	57.00	74.00
	5	0.65 ID# 290602					34.43	61.54	84.91
		2.65 White Hollow					35.54	43.10	73.33
	16.9						43.07	56.82	81.25
	0								
17.15	Lick Log Cre	eek					15.75	50.41	100.00
16.30	Jesse Creek						20.00	46.44	86.15
12.70	Pond Creek						19.53	49.85	78.63
8.45	Perkins Cree					16.16	34.81	40.67	104.59
	5.75						31.43	57.06	109.57
	8.00						69.80	54.84	122.43
0.00		SUBBASIN AVE. GRADIENTS		1.65	8.97	23.42	39.89	60.27	99.92
29.90	Hawker Cree	k				6.32	7.73	40.97	76.63
	4.75	Clubb Creek					30.38	52.94	100.00
	5.45	Virgin Creek					22.17	47.49	160.00
28.45	Cane Creek						16.29	52.55	130.50
28.30	Dry Creek						19.56	33.23	30.91
25.45	Malone Cree						7.69	42.43	42.11
22.70	Gizzard Cree				4 ~ 4	4400	13.07	50.31	110.77
20.30	Crooked Cre				4.04	14.89	21.60	28.73	52.63
	42.6						31.18	48.95	75.00
	41.3 31.8						28.42 41.36	47.19 78.33	81.60 142.86
	24.8					20.07	30.67	78.33 45.29	63.00
	24.0	5.7 ID# 310932				20.07	47.50	76.67	63.64
		4.6 Limbaugh Branch					43.24	57.14	88.89
	20.8	č				17.73	26.30	92.00	101.74
		4.4 Cedar Branch					39.09	49.76	111.43
	20.6	Opossum Creek					40.44	48.18	82.33
	14.7						13.33	50.00	63.89
	10.3					9.67	21.72	43.91	101.17

Table 2-A continued

MILE						7°	6°	5°	4°	3°	2°	1°
MAR		TRIBU	TARY N	IAME		GRAD	GRAD.	GRAD.	GRAD.	GRAD.	GRAD.	GRAD.
K												
		1.25	Granny	Creek						17.69	42.29	111.00
	3.9	ID# 30								25.56	37.69	97.78
10.77	CROOKED C		ASIN AV	E. GRA	DIENTS			4.04	15.59	30.58	53.33	88.35
18.55	No-Name ID#						2.60	2.56	11.20	16.26	35.75	143.54
17.65	Whitewater R 49.9		me ID#34	0030			2.68	3.56	11.30	38.57 56.00	97.50 78.33	150.00 187.14
	47.9		Hollow (44.71	82.67	88.27
	5	1viui tiii	110110W	CK.						11.71	02.07	00.27
	46.0	Blue C	reek							32.78	90.43	140.00
	41.8	Shrum	Creek							43.42	58.00	106.67
	38.8	Jack C	reek							36.63	66.67	85.71
	36.3	1	ollow Cree	ek						43.60	83.08	145.00
	29.3	Wolf C	Creek							25.89	37.64	67.50
	5	_										
	24.6	Caney		D 1					13.11	28.57	48.57	26.67
		1.85 6.2	Sandy ID# 33							25.82	51.76	126.71 73.57
		12.2	ID# 33							18.22 49.00	30.80 64.00	81.82
	20.8		me ID#32							88.00	55.09	98.00
	20.1		Whitewate					10.00	22.35	30.11	65.93	160.00
		2.0	Panthe							31.23	79.26	88.89
		6.7	Little l	Muddy (Ck.					23.37	44.24	69.33
		11.2	Mayfie	ld Ck.						34.41	60.00	120.00
		17.7	Stones	Branch					26.65	62.00	110.00	102.50
			1.7	_	20911					58.46	70.59	105.26
			19.7		nore Ck.					49.79	80.00	122.22
	16.8 5	Schrod	er Branch	L						8.82	57.14	250.00
	14.0	Dillard	Creek							36.63	71.67	76.47
	12.0 5	Byrd C	reek					6.81	7.56	28.00	52.00	80.00
			2.35	Cane	Creek				7.02	14.80	27.45	56.25
				0.1	Helderman C	Čk.				4.00	36.80	53.30
				5.7	ID# 311204					17.62	31.43	38.24
			10.9	Horre	ll Ck.					18.68	33.93	80.00
			12.8	ID# 3	21209					34.19	42.86	86.60
	10.2	No-Na	me ID# 3	11236						30.00	30.56	170.00
	WHITEWAT	ER R SU	IBBASIN	AVE	GRADIENTS		2.68	6.79	14.67	34.94	59.95	104.66
14.8	Bean Branch	Ert rt. De	BBIIBII	11,12,	OTT. ID ILL (ID		2.00	0.77	9.79	8.40	22.06	98.52
	2.9	No-Na	me ID# 3	01230						1.24	1.00	56.88
12.0	No-Name ID#	301228								17.40	22.05	103.09
10.95	No-Name ID#	301227								13.56	10.38	56.50
9.45	Hubble Creek					<u> </u>		6.84	5.40	17.49	31.26	95.65
	4.65	Willian	ns Creek	1 _					3.30	17.47	45.00	105.26
	- 0 -		3.3	Rand	ol Ck.	 				20.00	20.50	87.50
	6.05	Foster		1000						6.71	20.35	122.22
	11.0	_	me ID#31	1223		 				20.00	26.15	85.71
2.25	11.8 Ramsey Creek	Goose	Стеек			 			6.11	20.39 8.35	40.00 21.71	88.89 67.27
۷.۷3	2.7	Sals C	reek						0.11	5.95	26.06	85.71
0.9					 				27.00	18.00	74.18	
	·					1						
	Headwater Diversion Channel 0.0				0.69	1.42		See Cas	tor River Ma	instem		
0.0	Tiedewater Di											

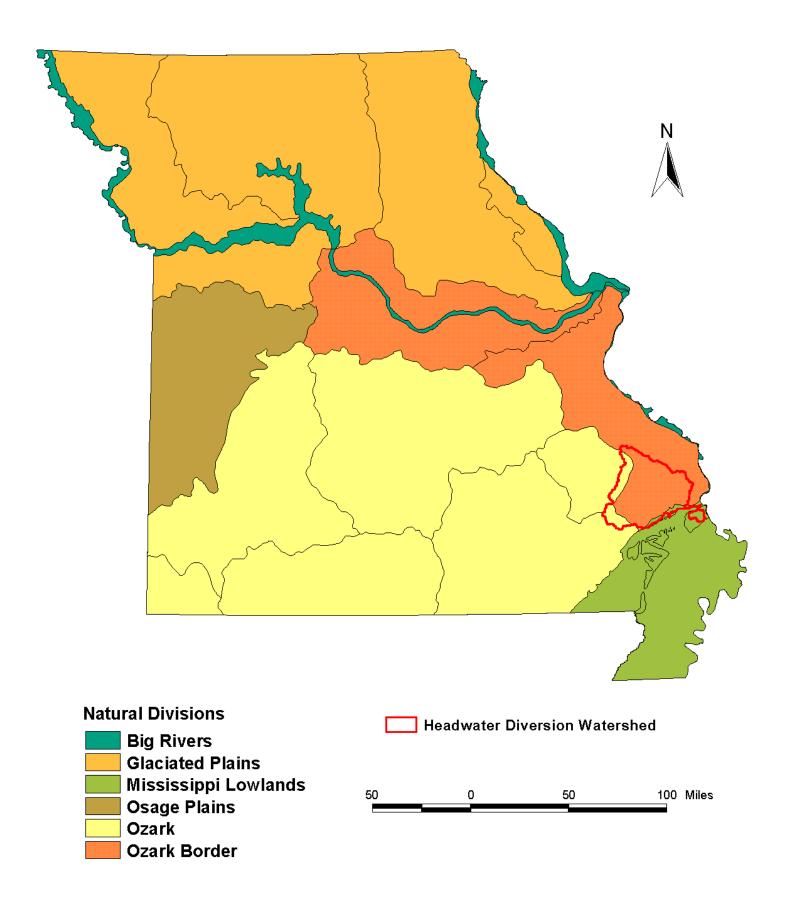
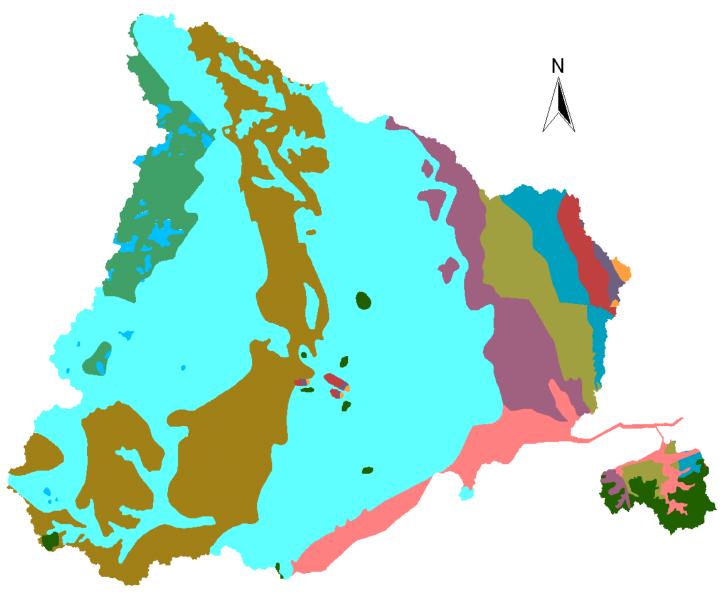
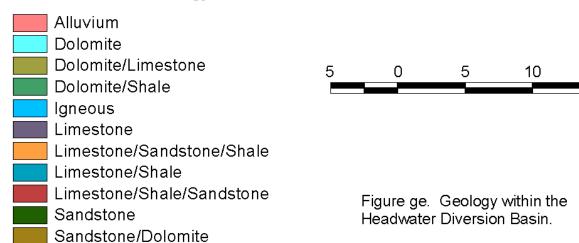


Figure nd. Natural divisons of the Headwater Diversion Basin in Missouri.



Headwater Geology

Sandstone/Limestone



15 Miles